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A SYSTEMATIC APPROACH TO ODOR SOURCE IDENTIFICATION IN THE INDOOR ENVIRONMENT

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Introduction

- From 60s, Environmental control has been growing.
- Water is widely controled.
- Air control is so spread and analytical methods are old and not renewed
- EPA, NIOSH, OSHA and ASTM methods are compound specific and sorbent dependant, ex:
 - ◆ NIOSH 2500 for 2-Butanone (MEK), sorbent: Carboxen 564
 - ◆ OSHA 111 for Toluene, sorbent: coconut charcoal or Carbosieve SIII (Anasorb 747)

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Overview

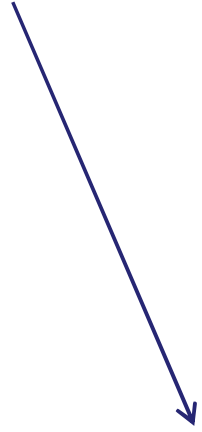
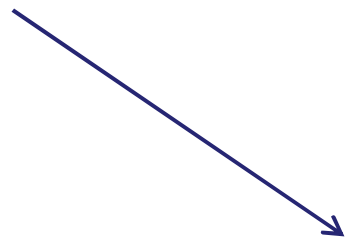
- Optimization of a generic method to analyze volatile compounds in indoor air for:
 - ◆ Qualitative identification of a broad range of compounds in air to identify odor sourcesand
 - ◆ Quantitation of selected compounds in air to determine the global sample odor
- Both approaches done on the same analysis
- Systematization of data interpretation to give odor source interpretation
 - ◆ Odor Units
 - ◆ Discomfort calculation
- Complete problem diagnosis

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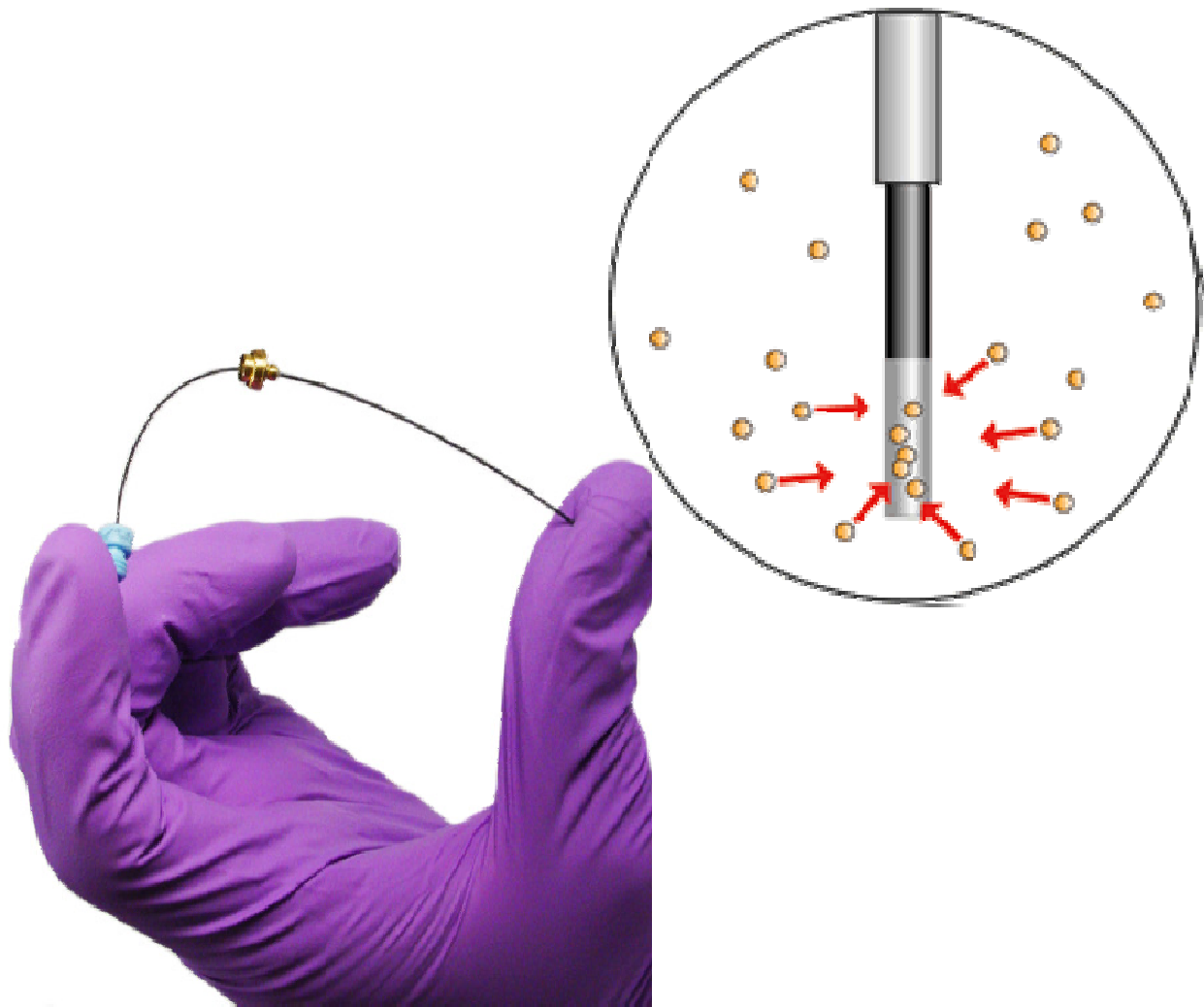


Available Techniques

- Direct air sampling with (Tedlar) bag
- Absorption tube
- SPME



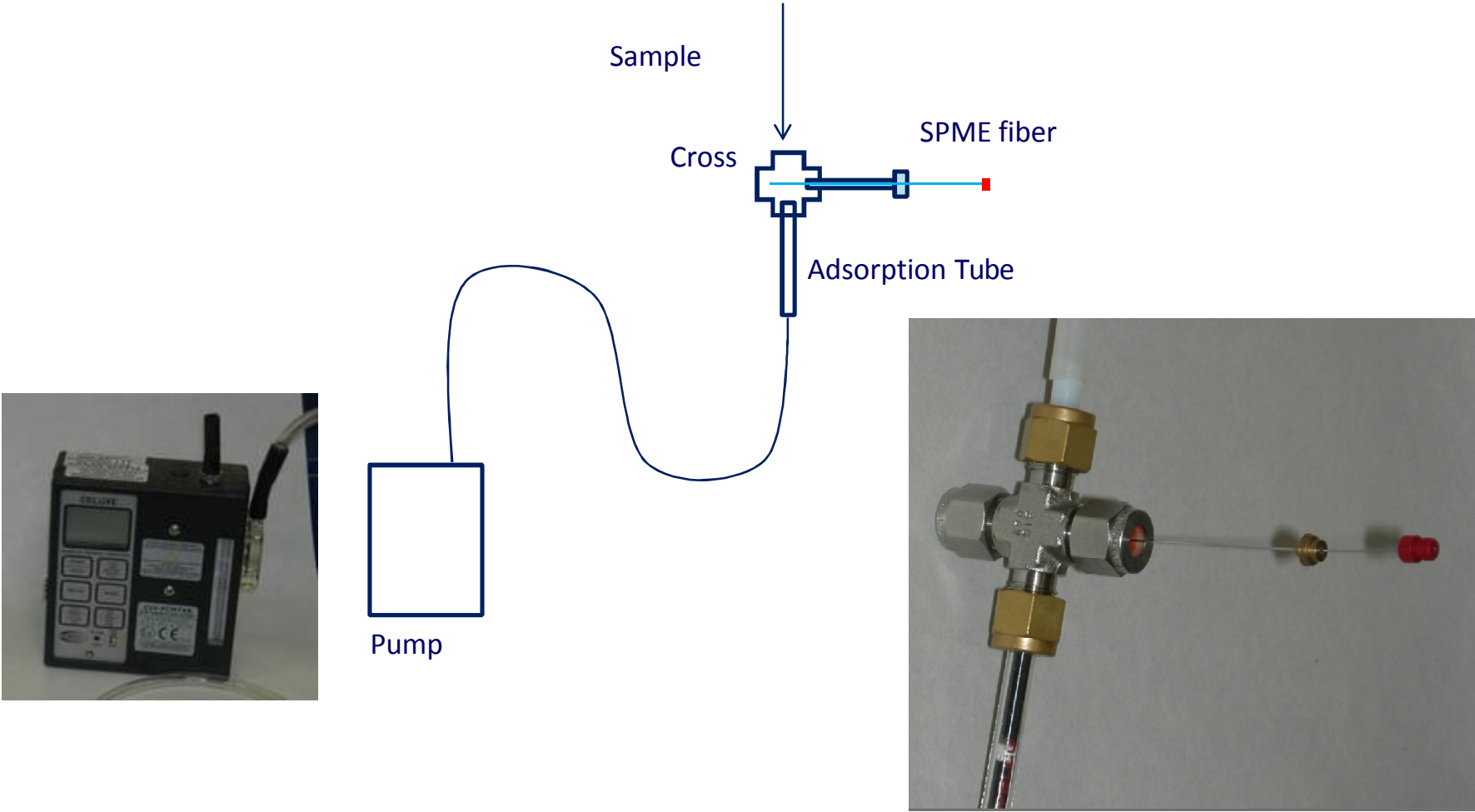
SPME (Solid Phase MicroExtraction)



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Connection schematics



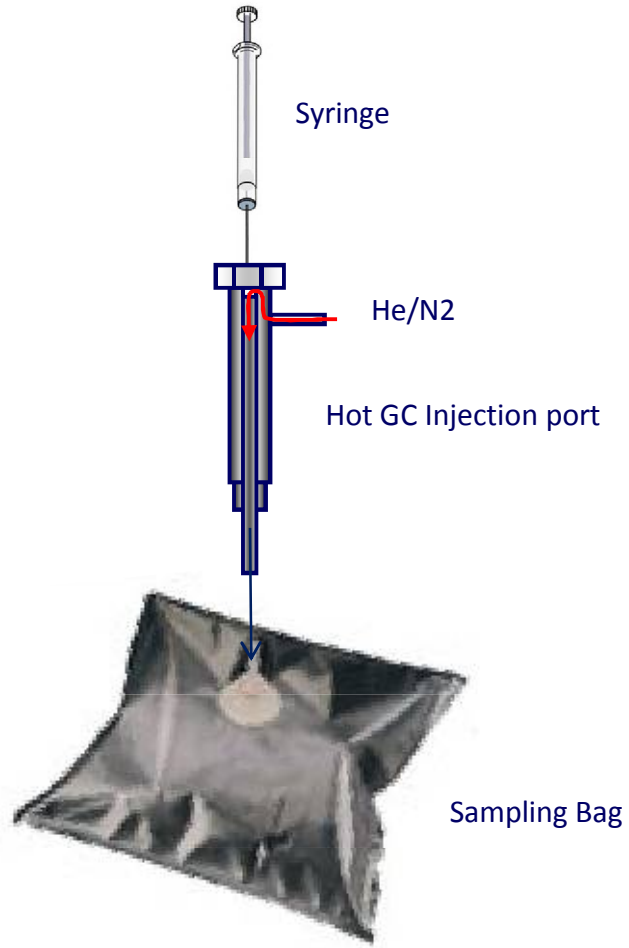
Connection schematics



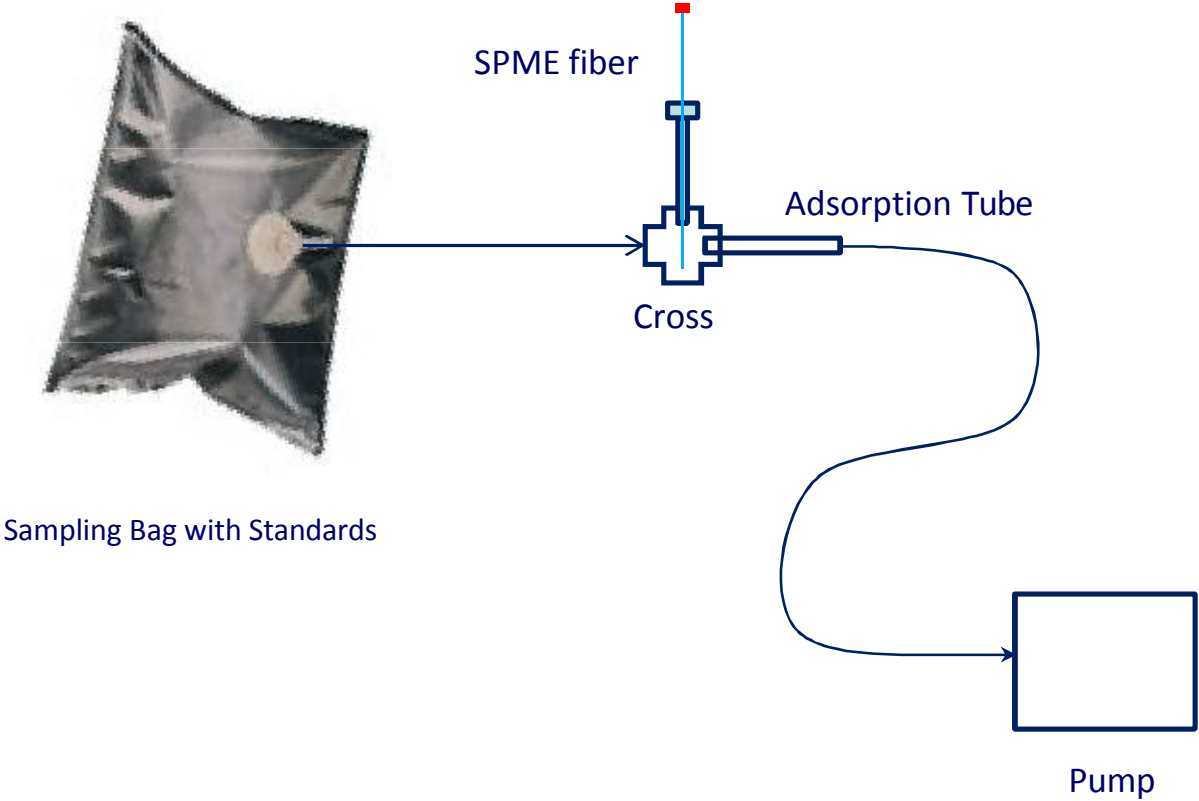
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Calibration



Connection schematics



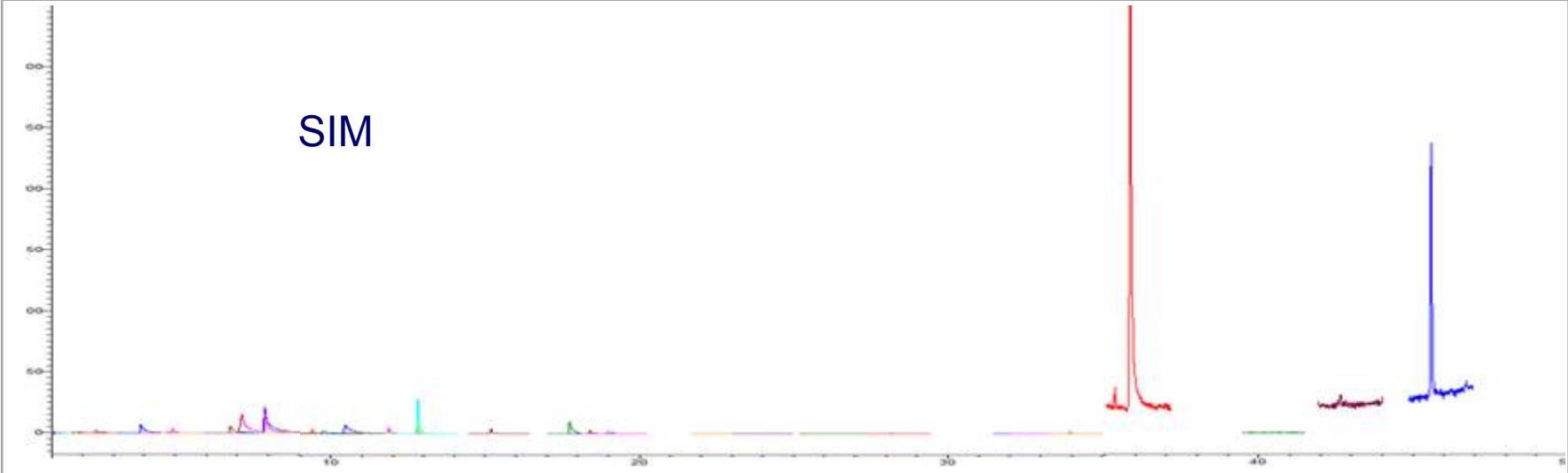
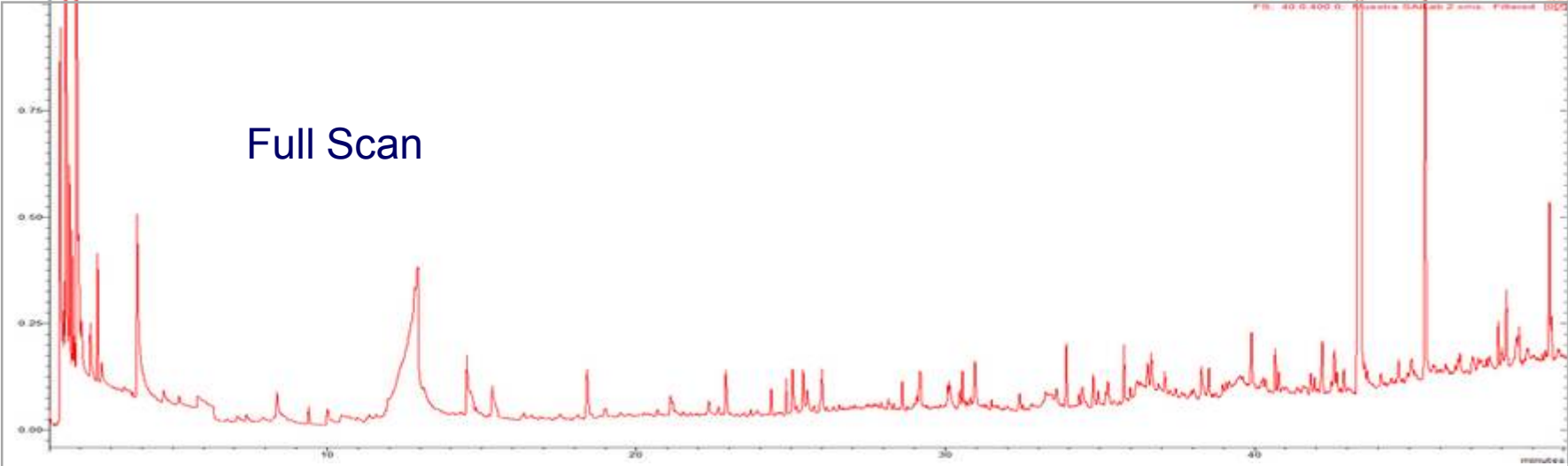
Screening compounds. By Chemical Family

2,4,6-Trimethylcyclohexyl)methanol (S)-3-Ethyl-4-methylpentanol alpha-Bisabolol 1,10-Decanediol 1,4-Benzenediol, 2,6-bis(1,1-dimethylethyl)- 1-Decanol, 2-ethyl- 1H-Cyclopropyl[azulen-4-yl, decahydro-1,1-heptandiol 1-Heptanol, 2-propyl- 1H-Indene-1,2-diol, 2,3-dihydro- 1-Octanol, 2-butyl- 1-Peranol 1-Peranol, 2-methyl- 2,6-Bis(1,1-dimethylethyl)-4-(1-oxopropyl)-2,7-octadien-1-ol 2-Dodecanol 2-Ethyl-1-Hexanol 2-Furanmethanol 2-Methyl-2,3-pentanediol 2-Nonen-1-ol, (Z)- 3,5-Octadien-2-ol 3-Buten-2-ol, 4-phenyl- Cinnamyl alcohol 4-Undecanol 7-Octen-2-ol, 2,6-dimethyl- Benzyl Alcohol Bornol Butylated Hydroxy Anisole Butylated Hydroxytoluene Cedran-diol, 8S,14 Cedrol cis-Pinen-3-ol Cyclohexanol, 2-(1,1-dimethylethyl)- Cyclopentanol, 2-methyl-, acetate, trans DBBP Eugenol Menthol Phenol Phenol, 2-(1,1-dimethylethyl)-4-methyl- Phenol, 2,3-dichloro- Phenol, 2,4-bis(1,1-dimethylethyl)- Phenol, 2-methyl-5-(1-methylethyl)- Phenol, 4-(1-methyl-1-phenylethyl)- Phenol, 4-(2-propenyl)- Phenol, 4,4'-(1-methylethylidene)bis- Phenol, 4-methyl- Phenylethyl Alcohol alpha-Isomethyl Ionone D-(+)-Carvone 1-(4-tert-Butylphenyl)propan-2-one 1-(2-[2-(2-acetylloxiran-2-yl)-1,1-dimethyl-2-hydroxypropan-3-yl]-1,1-dimethyl-2-hydroxypropan-3-yl)hexan-2-yl 2(1H) Naphthalene, 3,4,4a,5,6,7-hexahydro- 2(1H) Furanone, 5-butylidene- 2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-4-(1-oxopropyl)phenol 2,6-di-tert-butylquinone 2-Butanone 2-Butanone, 3-methyl- 2-Buten-1-one, 1-(2,6,6-trimethyl-1,3-cyclohexadien-1-yl)- 2-Decanone 2-Heptanone, 6-methyl- 2-Hexanone 2-Methyl Ionone	2-Nonanone 2-Octanone 2-Pentadecanone 2-Tetradecanone 2-Tridecanone 2-Undecanone 3-Buten-2-one, 4-(2,6,6-trimethyl-1-cyclohexen-1-yl)- 3-Dodecanone 3-Hydroxy-2-butanone 3-Undecanone 4-Nonanone 4-Octen-3-one 5,9-Undecadien-2-one, 6,10-dimethyl- 5-Hepten-2-one, 6-methyl- 2-Butyl-2,7-octadien-1-ol Acetone Acetyphenone, 2,2',5'-trimethyl- Benzophenone Benzyl methyl ketone 2-Nonen-1-ol, (Z)- 3,5-Octadien-2-ol Camphor Chrysanthenone Cyclohexanone Cyclohexanone, 5-methyl-2-(1-methylethyl)- Cyclohexanone, cyclic trimethylene acetal Dihydroacetone diol Ethanone, 1-(2-hydroxyphenyl)- Ethanone, 1-cyclopentyl- Cedran-diol, 2,2-dihydroxy-1-phenyl- L-Fenchone Musks 3BA Nonan-3,5-dien-2-one Nonanone Thiuron Tonalide Verbenaone	Undecanal 1,3-Dioxolane, 2-heptyl-4-methyl- 1,3-Dioxolane, 2-propyl- 1,3-Dioxolane, 4-ethyl- 1,3-Dioxolane, 4-methyl-2-phenyl- 2,2-bis[trimethyl(1-hydroxyethyl)oxy]propane 3-Isobutyl-4,5-dimethyl-3H-isobenzofuran Ethanone, 1-(2-furanyl)- Furan, 2-(1-pentenyl)-, (E)- Furan, 2-ethyl- Furan, 2-phenyl- Irans-2-(2-Pentenyl)furan 2H-Pyran, tetrahydro-4-methyl-2-(2-methyl-1,2-benzenedicarboxylic acid) 4-Butylbenzoic acid 6-Hexadecanoic acid Acetic acid Benzoic acid Benzoylformic acid Butanoic acid Butanoic acid, 3-methyl- Decanoic acid Dodecanoic acid Hexanoic acid Hexanoic acid, 2-ethyl- Hexanoic acid, anthryl- n-Hexadecanoic acid Nonanoic acid Octadecanoic acid Octanoic acid Pentadecanoic acid Pentanoic acid Propanoic acid Sorbic acid Tetradecanoic acid	Hexadecanoic acid, methyl ester Hexanoic acid, ethyl ester Hexanoic acid, propyl ester Isobornyl acetate Isobutyric acid, phenethyl ester Isopentyl hexanoate Isopropyl Myristate Isopropyl Palmitate Methyl dihydrojasmonate Methyl salicylate n-Caprylic acid isobutyl ester n-Hexyl salicylate Octadecanoic acid, 2-methylpropyl ester Octanoic acid, 3-methylbutyl ester Pentadecanoic acid, 3-methylbutyl ester Pentanoic acid, 2,2,4-trimethyl-3-carboxyisopropyl Pentanoic acid, ethyl ester Phenyl ethyl acetate Phenyl ethyl isobutylate Propanoic acid, 2-methyl-, 2,2-dimethyl- Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxyethyl)- Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethyl- Propanoic acid, butyl ester Propanoic acid, ethyl ester Tetradecanoic acid, ethyl ester 1,2-Benzenedicarboxylic acid, diisooctyl Hexadecanoic acid Nonanoic acid Phthalic acid, isobutyl octyl ester Octadecanoic acid Benzene, 1,2-dimethoxy- Benzene, 4-ethyl-1,2-dimethoxy- Calixarene epoxide di-Butyl Ether Diphenyl ether Ethanol, 2-phenoxy- Eugenyl methyl ether Naphthalene, 2-ethoxy- Naphthalene, 2-methoxy- Pentane, 1-butoxy- tert-Butyl Methyl ether 1-Methoxy-2-propyl acetate 1-Propenyl-2-yl formate 2-Ethoxyethyl acetate 2-Ethoxyethyl acetate Phenol, 4-methoxy-, acetate Bornyl acetate Butanoic acid, 3-methyl-, 3-methylbutyl Butanoic acid, 3-oxo-, methyl ester Butanoic acid, propyl ester Decanoic acid, ethyl ester Decanoic acid, methyl ester Di(ac-butyl)2-methylsuccinate Diisobutyl adipate Diisobutyl succinate Dodecanoic acid, 1-methylethyl ester Ethyl Acetate Ethyl Benzoate Formic acid, butyl ester Geranyl acetate	1-Decene 5-Decene, (E)- 6-Dodecene, (E)- 2,3,3-Trimethyl-1-hexene 2,6-Octadiene, 2,6-dimethyl- 2-Decene, 4-methyl-, (Z)- 2-Dodecene, 4-methyl-, Pentene, 2,2,4-trimethyl- Squalene 2,3,4,4-Trimethyl-2-pentene 3a,4,5,6,7,7b-Hexahydro-4,7,7-trimethanoniden 4,7-Methano-1H-indene, 3a,4,7,7b-tetrahydropentalen cis-trans-2-Ethylbicyclo[4.0.0]decane Cyclododecane, 1-methyl-, Cyclohexane Cyclohexane, 1,4-dimethyl-2-(2-methylpropyl)- Cyclohexane, phenyl- Cyclohexane, propyl- Cyclopentane, methyl-, Naphthalene, 1,2,3,4,4a,5,8,8a-octahydro- Naphthalene, decahydro-2-methyl-, Neopentyldecylcyclohexane trans-cis-2,8-Dimethylspiro[5.5]undecane Decane Decanoic acid Dodecane Eicosane Heptadecane Hexadecane Hexane Diethyl Phthalate Nonadecane Octadecane 2-methoxyethyl ether Benzene, 1,2-dimethoxy- Pentane Calixarene epoxide di-Butyl Ether Undecane Unicosane 1,1,1,3,5,5',7,7'-Nonamethyl-3-(trimethyl-1-hexeno-, 2,5-dimethyl- 2,3-Dimethyldecane Hexane, 2,4-dimethyl- Hexane, 3-ethyl-, n-Pentane Nonane, 2,2,4,4,6,6,8,8-heptamethyl-, Pentane, 2,2,4,4-trimethyl- Benzene Ethylbenzene m-p-Xylene o-Xylene Toluene 1-(1-Butenyl)-4-methyl- 1,2,3,5-Tetramethylbenzene 1H-Indene, 1-ethylidene- 1H-Indene, 2,3-dihydro-1,1,3-trimethyl-3-phenyl- 1H-Indene, 2,3-dihydro-4,7-dimethyl-3-phenyl- 1H-Indene, 1-ethylidene-2-(2-methylpropyl)- 1H-Indene, 2-butyl-5-hexylchlorohydro- 1H-Indene, 3-methyl-, 2,4-Dimethylstyrene 2,6-Diisopropylpiperthalene Acenaphthene Cyclohexane, 2-propenyl-, Cyclooligoforene, 8,10-dihydro- Isoligoforene, 4,5,9,10-tetrahydro-	Benzene, 1-(methylthio)- Benzene, 1-(1-methylthio)ethyl-2-(1-methylthio)- Benzene, 1,2,3,4-tetramethyl-, Benzene, 1,2,3-trimethyl-, Benzene, 1,2,4,5-tetramethyl-, Benzene, 1,2,4-trimethyl-, Benzene, 1,3,5-trimethyl-, Benzene, 1-ethyl-4-ethyl-, Benzene, 1-ethyl-3-methyl-, Benzene, 1-methyl-2-(1-methylethyl)- Benzene, 1-methyl-2-(2-propenyl)- Benzene, 1-methyl-3-(1-methylethyl)- Benzene, 1-methyl-4-(1-methylethyl)- Benzene, hexyl-, Benzene, isopropyl-, Benzene, propyl-, Biphenyl Naphthalene Naphthalene, 1,2,3,4-tetrahydro-2,7-dimethyl Naphthalene, 1,2,3,4-tetrahydro-2-methyl Naphthalene, 1,2,3,4-tetrahydro-6-methyl Naphthalene, 1,2-dihydro-1,1,6-trimethyl Naphthalene, 1,4-dimethyl-, Naphthalene, 1-methyl-, Naphthalene, 2,3,6-trimethyl-, Naphthalene, 2-methyl-, Styrene alpha-Cubebene alpha-Muurolene alpha-Thujene beta-Copaene beta-Mycene beta-Pinene RR-alpha-Pinene 3-Carene 3-Cyclohexene-1-methanol, alpha_alpha alpha_cubebene b-Dimene b-Bourbonene b-Patchoulene Calanene Camphene Caryophyllene Cedrene Copaene Estragole Limonene Longiprene Quinone Patchoulene Satiene Terpene 10 Terpene 11 Terpene 1B Terpene 1G Terpene 5 Terpene 6 Terpene 2 Terpene 3	Terpene 4 Terpene 5 Terpene 6 Terpene 7 Terpene 9 Terpinolene Thujopsene trans-2-Pinanol Dimethyl Silanediol Ethanediol acid, bis(trimethylsilyl) ester Malonic acid, bis(2-trimethylsilyl) ester Silane, dimethylsilyloxyheptyloxy- Silane, trimethyl-, Cyclohexasiloxane, dodecamedyl-, Cyclopentasiloxane, octamethyl-, Cyclopentasiloxane, decamethyl-, Cyclohexasiloxane, octamethyl-, Cyclohexasiloxane, 2,4,6-triethyl-2,4,6 Cyclotrisiloxane, hexamethyl-, Heptasiloxane, hexadecamethyl-, Hexasiloxane, tetradecamethyl-, 1,2,4,5-Tetrazine, 3,6-dipropyl- 1,6-Octadecan-3-ol, 3,7-dimethyl-, 2-amin 1H-Indole, 3-methyl-, 1H-Pyrole, 3-methyl-, 1-Piperidinecarboxaldehyde 2-(3-Methylbutyl)-3,5-dimethylpyrazine 2,4-Toluene diisocyanate 2-Acetylpyrrole 3,6-Bis(N,N-dimethylamino)-9-methylcarbazole 3-Methoxy-2,5-dimethylpyrazine 4-Acetylaniline Benzene, 1-(n-butyl)- Benzene, N,N-dimethyl- Benzene, N,N-dimethylamino Benzene, N,N-dimethylamino, N,N-dimethyl-, Benzyl nitrile Benzylcarbamate Butanamide, 3,3-dimethyl-, Decanamide, n-pentyl-, Dimethylamine Ethanethanamide, N,N-dimethyl-, Ethane, 1,2-diphenyl-, oxime Formamide, N,N-diethyl-, Hexanenitrile Isobutylamine N,N,3,5-Tetramethylaniline N,N-Dimethylformamide n-Butylbenzenesulfonamide Oxime, methoxy-phenyl-, Pentane, 2-isocyanato-2,4,4-trimethyl-, Propylsulfonfylsulfacetate Pyridine Pyrazine, 2,3-dimethyl-, Pyrazine, 2-ethyl-6-methyl-, Pyrazine, 3-ethyl-2,5-dimethyl-, Pyrazine, ethyl-, Pyrazine, trimethyl-, Pyridine Pyridine, 2,3-dimethyl-, Pyridine, 2-ethyl-, Pyridine, 2-methyl-, Pyridine, 3-methyl-, Pyridine, 3-phenyl-	Pyrimidine, 2-methyl-, Quinazoline, 4-methyl-, Skatole Urea, tetraethyl-, 1,1,3,3,5,5-Hexamethyl-2-thia-1,3,5-tris 2,8-Dimethylbenzo[b]thiophene 2,8-Dimethylbenzo[b]thiophene 2-Furanmethanediol, 5-methyl-, 2-Heptanediol, 2-methyl-, 3,6-Dimethylbenzo[b]thiophene 3-Methylbenzothiazole 4-Methyl-5-ethylthiazole 4-Methylbenzothiazole Benzo[b]thiophene, 3,6-dimethyl-, Benzothiazole Benzyl methyl sulfide Carbon disulfide Cyclic octaatomic sulfur Dibenzothioephene, 3-methyl-, Dibenzothioephene, 4-methyl-, Dimethyl sulfide Dimethyl Sulfoxide Dimethyl trisulfide Disulfide, dimethyl Disulfide, methyl propyl Mercaptoacetic acid, bis(trimethylsilyl) Methanethiol Methyl ethyl disulfide Methyl isopropyl disulfide Methyl pentyl disulfide Methyl thymol ether Sulfone, butyl propyl Sulfur Sulfurous acid, butyl CO6 alkyl ester1 Sulfurous acid, butyl CO6 alkyl ester2 Sulfurous acid, butyl CO6 alkyl ester3 Sulfurous acid, butyl CO6 alkyl ester5 Sulfurous acid, butyl CO6 alkyl ester6 Sulfurous acid, butyl CO6 alkyl ester8 Sulfurous acid, butyl CO6 alkyl ester9 Tetrahydrothiazole Tetrahydrothiazole Thioamide, dimethyl Thiophene-2-acetic acid, dodec-9-ynyl ester Thioamide 1,2-Dimethoxy-3,5-dichloro-benzene 2,6-Dichloro-4-(1,1-dimethylethyl)phenol 3-Trifluoroacetoxypentadecane Benzenamine, 3,4-dichloro- Benzene, 1,2-dichloro-3-methyl-, Benzene, 1,4-dichloro- Bromoforn Butane, 1,2,2-tribromo- Chloroforn Cyclopropane, pentachloro- Dibromochloromethane Methane, bromodichloro- Methylene Chloride Phenol, 2-chloro-4-(1,1-dimethylethyl)- Tetrachloroethylene
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Alcohol
Phenol
Ketone
Aldehyde
Dioxolane
Furan
Pyran
Acid
Ester
Phthalate
Ether
Glycol-ester
Glycol-ether
HCO-C
HCO-L
HCO-R
HCS-C
HCS-L
HCS-R
HC-BTEX
HC-Ar
Terpene
SI
Silox
N
S
X



Example Chromatogram



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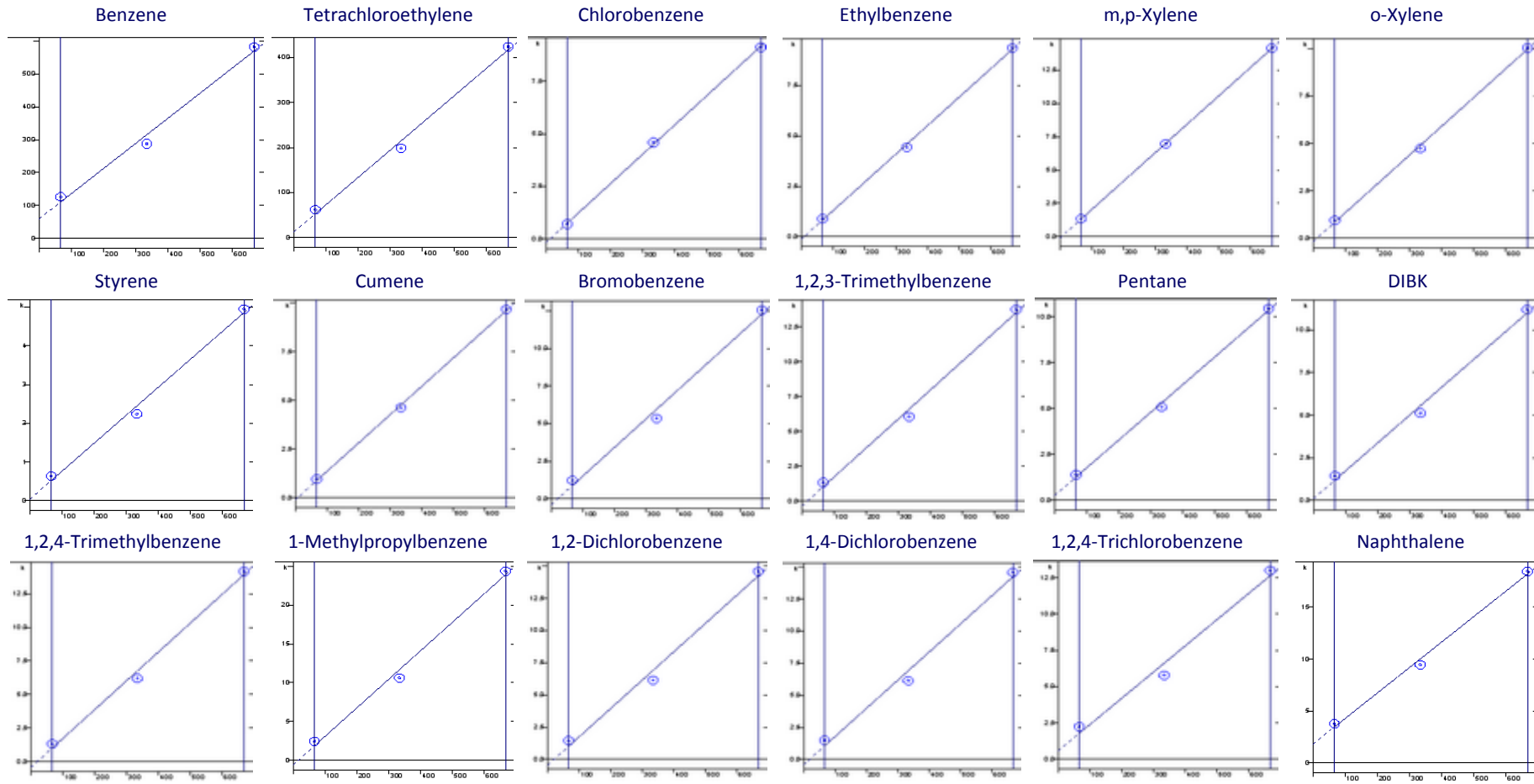
Example Chromatogram. Standard.



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Linearities



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Indoor air health effects assessment

Exposure range	Health effects	$\mu\text{g}/\text{m}^3$
comfort	none	<200
multifactorial	irritation, odors, possible discomfort	200-3.000
discomfort	odors, headache, elevated discomfort	3.000-25.000
toxic	health risk and possibly neurotoxic effects	>25.000

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Odor Threshold

2,4,6-Trimethylcyclohexyl methanol	2-Nonanone	Undecanal	Hexadecanoic acid, methyl ester	1-Decene	Benzene, 1-(methylthio)-	Terpene 4	Pyrimidine, 2-methyl-
(S)-3-Ethyl-4-methylpentanol	2-Octanone	1,3-Dioxolane, 2-heptyl-4-methyl-	Hexanoic acid, ethyl ester	5-Decene, (E)-	Benzene, 1-(1-methylthio)-2-(1-methylthio)	Terpene 5	Quinoxaline, 4-methyl-
alpha-Bisabolol	2-Pentadecanone	1,3-Dioxolane, 2-propyl-	Hexanoic acid, propyl ester	6-Dodecene, (E)-	Benzene, 1,2,3,4-tetramethyl-	Terpene 6	Skatole
1,10-Decanediol	2-Tetradecanone	1,3-Dioxolane, 4-ethyl-	Isobornyl acetate	2,3,3-Trimethyl-1-hexene	Benzene, 1,2,3-trimethyl-	Terpene 7	Urea, tetraethyl-
1,4-Benzoxazol-2(1H)-one	2-Tridecanone	1,3-Dioxolane, 4-methyl-2-phenyl-	Isobutyric acid, phenethyl ester	2,6-Octadiene, 2,6-dimethyl-	Benzene, 1,2,4,5-tetramethyl-	Terpene 8	1,1,3,3,5-Hexamethyl-2-thia-1,3,5-tria-
1-Decenal	2-Undecanone	2,2-Bifuran	Isopentyl hexanoate	2-Decene, 4-methyl-, (Z)-	Benzene, 1,2,4-trimethyl-	Terpinolene	2,8-Dimethylbenzob[d]thiophene
1H-Cyclopenta[ajulene]-4-ol, decahydro-1-	3-Buten-2-one, 4-(2,6,6-trimethyl-1-cyclohexen-1-yl)-	3-Isobutyl-4,5-dimethyl-3H-isobenzofuran	Isopropyl Myristate	2-Dodecene, 4-methyl-	Benzene, 1,3,5-trimethyl-	Thujopene	2,8-Dimethylbenzob[d]thiophene
1-Heptanol	3-Dodecanone	Ethanone, 1-(2-furanyl)-	Isopropyl Palmistate	Pentene, 2,2,4-trimethyl-	Benzene, 1,3-dimethyl-	trans-2-Pinanol	2-Furanmethanethiol, 5-methyl-
1-Heptanol, 2-propyl-	3-Hydroxy-2-butanone	Furan, 2-(1-pentenyl-, (E)-)	Methyl dihydroasmatate	Squalene	Benzene, 1-ethenyl-4-ethyl-	Dimethyl Silanediol	2-Heptanethiol, 2-methyl-
1H-Indene-1,2-diol, 2,3-dihydro-	3-Undecanone	Furan, 2,5-dimethyl-	Methyl salicylate	2,3,4,4-Trimethyl-2-pentene	Benzene, 1-ethyl-3-methyl-	Ethanedioic acid, bis(trimethylsilyl) ester	3,6-Dimethylbenzob[thiopheno]
1-Octanol, 2-butyl-	4-Nonanone	Furan, 2-ethyl-	n-Caprylic acid (isobutyl) ester	3,4,5,5,7,7a-Hexahydro-4,7-trimethyloctaliden	Benzene, 1-methyl-2-(1-methylthio)	Melonic acid, bis(trimethylsilyl) ester	3-Methylbenzob[thiopheno]
1-Pentanol	4-Octen-3-one	Furan, 2-pentyl-	n-Hexyl salicylate	4,7-Methano-1H-indene, 3a,4,7,7a-tetrahy-	Benzene, 1-methyl-2-(2-propenyl)	Silane, dimethylbisobutylheptyloxy-	4-Methyl-5-ethylthiazole
1-Pentanol, 2-methyl-	5,9-Undecadien-2-one, 6,10-dimethyl-	trans-2-(2-Pentyl)furan	Octadecanoic acid, 2-methylpropyl ester	cis,trans-2-Ethylbicyclo[4,4,0]decane	Benzene, 1-methyl-3-(1-methylthio)	Silane, trimethyl-	4-Methylbenzob[thiopheno]
2,6-Bis(1,1-dimethylthio)-4(1-oxopropyl)-2-butyl-2,7-octadien-1-ol	5-Hepten-2-one, 6-methyl-	2H-Pyran, tetrahydro-4-methyl-2-(2-methyl-1,2-benzenedicarboxylic acid)	Octanoic acid, 3-methylbutyl ester	Cyclododecane, 1-methyl-	Benzene, 1-methyl-3-propyl-	Cyclohexasiloxane, dodecamethyl-	Benzob[thiopheno], 3,6-dimethyl-
2-Ethyl-1-Hexanol	Acetone	4-Butylbenzoic acid	Penitadecanoic acid, 3-methylbutyl ester	Cyclohexane	Benzene, 1-methyl-4-(1-methylthio)	Cyclopentasiloxane Octamethyl	Benzothiazole
2-Furanmethanol	Acetylacetic acid, 2,2,5-trimethyl-	2-Butylbenzoic acid	Penitadecanoic acid, 2,2,4-trimethyl-3-carboxyisopropyl	Cyclohexane, pentyl-	Benzene, hexyl-	Cyclopentasiloxane, decamethyl-	Benzyl methyl sulfide
2-Methyl-2,3-pentanediol	Benzophenone	Acetic acid	Penitadecanoic acid, ethyl ester	Cyclohexane, propyl-	Benzene, nonyl-	Cyclohexasiloxane, octamethyl-	Carbon disulfide
2-Nonen-1-ol, (Z)-	benzyl methyl ketone	Benzoic Acid	Phenyl ethyl acetate	Cyclopentane, methyl-	Biphenyl	Cyclotrisiloxane, 2,4,6-trimethyl-2,4,6	Cyclic octasulfonic sulfur
3,5-Octadien-2-ol	n-Butyl Isonone	Benzoylformic acid	Phenyl ethyl isobutrate	Naphthalene, 1,2,3,4,4a,5,8a-octahydro-	Naphthalene	Cyclotrisiloxane, hexamethyl-	Dibenzothioephene, 3-methyl-
3-Buten-2-ol, 4-phenyl-	Butyloctadien-2-ol	Butanoic acid	Propanoic acid, 2-methyl-, 2,2-dimethyl-	Naphthalene, 1,2,3,4-tetrahydro-2,7-dimethyl-	Naphthalene, 1,2,3,4-tetrahydro-2,7-dimethyl	Heptasiloxane, hexadecamethyl-	Dibenzothioephene, 4-methyl-
4-Hexyl-2-ol	Camphor	Butanoic acid, 2-methyl-	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxypropanoic acid, 2-methyl-, 3-hydroxy-2,4	Neopentylidenedicyclohexane	Naphthalene, 1,4-dimethyl-	Hexasiloxane, tetradecamethyl-	Dimethyl sulfide
4-Undecanol	Cyclohexanone	Decanoic Acid	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethyl-	trans-cis-2,8-Dimethylspiro[5]undecane	Naphthalene, 1,2,3,4-tetrahydro-9-methyl-	Hexasiloxane, tetradecamethyl-	Dimethyl Sulfoxide
7-Octen-2-ol, 2,6-dimethyl-	Cyclohexanone, 5-methyl-2-(1-methylthio)	Dodecanoic acid	Propanoic acid, butyl ester	Decane	Naphthalene, 1,2-dihydro-1,1,6-trimethyl-	Hexasiloxane, tetradecamethyl-	Disulfide, methyl propyl
Benzyl Alcohol	Cyclohexanone, cyclic trimethylene aceta	Hexanoic acid, 2-ethyl-	Propanoic acid, ethyl ester	Dodecane	Docosane	1-Piperidinecarboxaldehyde	Mercaptoacetic acid, bis(trimethylsilyl)
Borneol	Dihydroacetic diolide	Hexanoic acid, 2-ethyl-	Tetradecanoic acid, ethyl ester	Eicosane	Naphthalene, 2,3,6-trimethyl-	2-(3-Methylbutyl)-3,5-dimethylpyrazine	Methanolic acid
Butylated Hydroxy Anisole	Ethanoone, 1-(2-hydroxyphenyl)-	Hexanoic acid, ethylthioide	1,2-Benzenedicarboxylic acid, diisooctyl	Heptadecane	Naphthalene, 2-methyl-	2,4-Toluene diisocyanate	Methyl ethyl disulfide
Butylated Hydroxytoluene	Ethanoone, 1-cyclohexyl-	n-Hexadecanoic acid	Dibutyl phthalate	Hexadecane	Shrene	2-Acetylpyrene	Methyl isopropyl disulfide
Cedran-diol, 6S,14-	Ethanoone, 2,2-dihydroxy-1-phenyl-	Nonanoic acid	Diethyl Phthalate	Hexane	alpha-Cubebene	3,6-Bis(N,N-dimethylamino)-9-methylcarbazole	Methyl pentyl disulfide
Cedrol	L-Fenchone	Octadecanoic acid	Phthalic acid, isobutyl octyl ester	Nonadecane	alpha-Murrolene	3-Methoxy-2,5-dimethylpyrazine	Methyl thymol ether
cis-Pinen-3-ol	Musk 3BA	Octanoic Acid	2-methoxyethyl ether	Octadecane	alpha-Thujene	4-Acetylaniline	Sulfone, butyl propyl
Cyclohexanol, 2-(1,1-dimethylthio)-	Nona-3,5-dien-2-one	Pentadecanoic Acid	Benzene, 1,2-dimethoxy-	Pentadecane	beta-Gualene	Benzene, (1-nitrothio)	Sulfur
Cyclopentanol, 2-methyl-, acetate, trans	Nonanone	Penitadecanoic acid	Benzene, 4-ethyl-1,2-dimethoxy-	Pentane	beta-Myracene	Benzocyclopentadiene	Sulfurous acid, butyl C6H5 alkyl ester1
DTBBP	Thujone	Propanoic acid	Calarene epoxide	Tetradecane	beta-Pinene	Benzenemethanamine, N,N-dimethyl-	Sulfurous acid, butyl C6H5 alkyl ester2
Eugenol	Tonide	Sorbic Acid	Di-Butyl Ether	Undecane	1R-alpha-Pinene	Benzyl nitrile	Sulfurous acid, butyl C6H5 alkyl ester3
Menthol	Verbenone	Tetradecanoic acid, 2-hydroxy-	Diphenyl ether	Unicosane	3-Carene	Benzylcarbamate	Sulfurous acid, butyl C6H5 alkyl ester5
Phenol	1-Cyclohexene-1-carboxaldehyde, 2,6,6-tri-	Tetradecanoic acid, 2-hydroxy-	Ethanol, 2-phenoxy	Ethanol, 2-phenoxy	1,1,1,3,5,5,7,7-Nonamethyl-3-(trimethyl-1-hexenyl)-2,5-dimethyl-	Butanamide, 3,3-dimethyl-	Sulfurous acid, butyl C6H5 alkyl ester6
Phenol, 2-(1,1-dimethylthio)-4-methyl-	2-Furanacetaldehyde, 5-methyl-	2-Propenoic acid, butyl ester	Eugenyl methyl ether	Eugenyl methyl ether	1-Hexene, 2,5-dimethyl-	Decanamide, n-pentyl-	Sulfurous acid, butyl C6H5 alkyl ester7
Phenol, 2,3,6-trichloro-	2-Octenal, (E)	3-Methylmethyl acetate	Naphthalene, 2-ethoxy	Naphthalene, 2-ethoxy	2,3-Dimethyldecane	Diethylformamide	Sulfurous acid, butyl C6H5 alkyl ester8
Phenol, 2,4-bis(1,1-dimethylthio)-	2-Propenal, 3-phenyl-	4-Decenoic acid, ethyl ester	Naphthalene, 2-methoxy	Hexane, 2,4-dimethyl-	Hexane, 3-ethyl-	Ethanedioic acid, N,N-dimethyl-	Sulfurous acid, butyl cyclohexylmethyl ester
Phenol, 2-methyl-5-(1-methylthio)-	3,5-di-tert-Butyl-4-hydroxybenzaldehyde	4-tert-Butylcyclohexyl acetate	Acetic acid, 2-phenylethyl ester	Hexane, 3-ethyl-	Pentane, 1-butoxy-	Ethanoone, 1,2-diphenyl-, oxime	Tetrahydrothiazole
Phenol, 4-(1-methyl-1-phenylethyl)-	Benzaldehyde	Acetic acid, 2-phenylethyl ester	Benzaldehyde	Hexane, 3-ethyl-	tert-Butyl Methyl ether	Formamide, N,N-diethyl-	Tetrahydrothiazole
Phenol, 4-(2-propenyl)-	Benzaldehyde, 2,4,5-trimethyl-	Acetic acid, butyl ester	Benzaldehyde, 2,4,5-trimethyl-	Hexane, 3-ethyl-	1-Methoxy-2-propyl acetate	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
Phenol, 4-(4-(1-methylthio)thiolenyl)-	Benzaldehyde, 2,4,8-trimethyl-	Acetic acid, heptyl ester	Benzaldehyde, 2,4,8-trimethyl-	Hexane, 3-ethyl-	1-Propen-2-ol, formate	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
Phenol, 4-methyl-	Benzaldehyde, 2,4-dimethyl-	Benzoylpropionic acid, ethyl ester	Benzoylpropionic acid, ethyl ester	Hexane, 3-ethyl-	2-Propen-2-ol, formate	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
Phenylthyl Alcohol	Benzaldehyde, 3,4-dimethyl-	Benzoylpropionic acid, ethyl ester	Benzoylpropionic acid, ethyl ester	Hexane, 3-ethyl-	2-Ethoxyethyl acetate	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
alpha-Isomethyl Isonone	Benzaldehyde, 4-ethyl-	Benzyl Benzoate	Benzyl Benzoate	Hexane, 3-ethyl-	Phenol, 4-methoxy-, acetate	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
D-(+)-Carvone	Benzaldehyde, 4-hydroxy-	Bornyl acetate	Bornyl acetate	Hexane, 3-ethyl-	2-Propanol, 1-butoxy-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
1-(4-tert-Butylphenyl)propan-2-one	Benzaldehyde, 4-pentyl-	Butanoic acid, 3-methyl-, 3-methylbutyl	Butanoic acid, 3-methyl-, 3-methylbutyl	Hexane, 3-ethyl-	2-Propanol, 1-ethoxy-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
1-(2-(2-Acetyloxy)propan-2-yl)-1,1-dimeth	Bismolal, 2-methyl-	Butanoic acid, propyl ester	Butanoic acid, propyl ester	Hexane, 3-ethyl-	2-Propanol, 1-methoxy-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2(1H)-Naphthalenone, 3,4,4a,5,6,7-hexalyl	Decanal	Decanoic acid, ethyl ester	Decanoic acid, ethyl ester	Hexane, 3-ethyl-	Diethylene glycol diethyl ether	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2(3H)-Furanone, 5-butylthiohydro-	Decanediol	Decanoic acid, methyl ester	Decanoic acid, methyl ester	Hexane, 3-ethyl-	Dipropylene glycol methyl ether	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,2,6-Bis(1,1-dimethylthio)-4-(1-oxopropyl)phenol	Furfural	Di(dec-butyl) 2-methylsuccinate	Di(dec-butyl) 2-methylsuccinate	Hexane, 3-ethyl-	Ethane, 1,1'-oxybis(2-ethoxy)-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2,5-Gerbutylquinone	Heptanal	Diisobutyl adipate	Diisobutyl adipate	Hexane, 3-ethyl-	Ethane, 1,1'-oxybis(2-ethoxy)-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2-Butanone	Hexanal	Diisobutyl succinate	Diisobutyl succinate	Hexane, 3-ethyl-	Ethanol, 2-(2-ethylthio)ethylthio	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2-Butanone, 3-methyl-	Hexanal, 2-ethyl-	Dodecanoic acid, 1-methylthio ester	Dodecanoic acid, 1-methylthio ester	Hexane, 3-ethyl-	Ethanol, 2-butoxy-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2-Buten-1-one, 1-(2,6,6-trimethyl-1,3-cy	linal	Ethyl Acetate	Ethyl Acetate	Hexane, 3-ethyl-	Triethylene glycol ethyl ether	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2-Decanone	Nonanal	Ethyl Benzoate	Ethyl Benzoate	Hexane, 3-ethyl-	1,4-Cyclohexadiene, 1-methyl-4-(1-methyl-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2-Heptanone, 6-methyl-	Octanal	Formic acid, butyl ester	Formic acid, butyl ester	Hexane, 3-ethyl-	Cyclohexane, 2-propenyl-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2-Hexanone	Octanal	Formic acid, butyl ester	Formic acid, butyl ester	Hexane, 3-ethyl-	Cycloisolongifolene, 8,10-dihydro-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
2-Methyl Isonone	Octanal, 2-(phenylmethyl)enyl	Geranyl acetate	Geranyl acetate	Hexane, 3-ethyl-	Isolongifolene, 4,5,9,10-dihydro-	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester

< 15 µg/m³
15-500 µg/m³
> 500 µg/m³

Lab.



Odor Units

- Calculated

$$OU_c = \sum \frac{[]_i}{OTh_i}$$

- Actual



SALab.



Air Quality Criteria (AQC)

2,4,6-Trimethylcyclohexyl methanol	2-Nonanone	Undecanal	Hexadecanoic acid, methyl ester	1-Decene	Benzenes, (1-methyl-)	Terpene 4	Pyrimidine, 2-methyl-
(S)-3-Ethyl-4-methylpentanol	2-Octanone	1,3-Dioxolane, 2-heptyl-4-methyl-	Hexanoic acid, ethyl ester	5-Decene, (E)-	Benzene, 1-(1-methylethyl)-2-(1-methyl	Terpene 5	Quinoxaline, 4-methyl-
alpha-Bisabolol	2-Pentadecanone	1,3-Dioxolane, 2-propyl-	Hexanoic acid, propyl ester	6-Dodecene, (E)-	Benzene, 1,2,3,4-tetramethyl-	Terpene 6	Skatole
1,10-Decanediol	2-Tetradecanone	1,3-Dioxolane, 4-ethyl-	Isobornyl acetate	2,3,3-Trimethyl-1-hexene	Benzene, 1,2,3-trimethyl-	Terpene 7	Urea, tetraethyl-
1,4-Benzenediol, 2,6-bis(1,1-dimethyleth	2-Tridecanone	1,3-Dioxolane, 4-methyl-2-phenyl-	Isobutylic acid, phenethyl ester	2,6-Octadiene, 2,6-dimethyl-	Benzene, 1,2,4,5-tetramethyl-	Terpene 9	1,1,3,3,5-Hexamethyl-2-thia-1,3,5-tis
1-Octanol, 2-butyl-	2-Undecanone	2,2-Dihexan	Isopentyl hexanoate	2,2-Decene, 4-methyl-, (Z)	Benzene, 1,2,4-trimethyl-	Terpinolene	2,8-Dimethylbenzobicyclophane
1H-Cyclopropyl[azulen-4-yl, decahydro-1,	3-Buten-2-one, 4-(2,6,6-trimethyl-1-cyclohex-1-yl)	3-Isobutyl-4,5-dimethyl-3H-azobenzofuran	Isopropyl Myristate	2-Dodecene, 4-methyl-	Benzene, 1,3,5-trimethyl-	Thujopene	2,8-Dimethylbenzobicyclophane
1-Heptanol	3-Dodecanone	Ethanoane, 1-(2-furanyl)-	Isopropyl Palmistate	Pentene, 2,2,4-trimethyl-	Benzene, 1,3-dithethyl-	trans-2-Pinanol	2-Furanmethanethiol, 5-methyl-
1-Heptanol, 2-propyl-	3-Hydroxy-2-butanone	Furan, 2-(1-pentyl-, (E)-	Methyl dihydrojasmonate	Squalene	Benzene, 1-ethenyl-4-ethyl-	Dimethyl Silanediol	2-Heptanethiol, 2-methyl-
1H-Indene-1,2-diol, 2,3-dihydro-	3-Undecanone	Furan, 2,5-dimethyl-	Methyl salicylate	2,3,4,4-Trimethyl-2-pentene	Benzene, 1-ethyl-3-methyl-	Ethanedioic acid, bis(trimethylsilyl) ester	3,6-Dimethylbenzobicyclophane
1-Octanol, 2-butyl-	4-Nonanone	Furan, 2-ethyl-	n-Caprylic acid isobutyl ester	3,4,5,5,7,7a-Hexahydro-4,7-trimethyloctaliden	Benzene, 1-methyl-2-(1-methylethyl)-	Malonic acid, bis(trimethylsilyl) ester	3-Methylbenzobicyclophane
1-Pentanol	4-Octen-3-one	Furan, 2-pentyl-	n-Hexyl salicylate	4,7-Methano-1H-indene, 3a,4,7,7a-tetrahy	Benzene, 1-methyl-2-(2-propenyl)-	Silane, dimethylisooxoynepeyloxy-	4-Methyl-5-ethylimidazole
1-Pentanol, 2-methyl-	5,9-Undecadien-2-one, 6,10-dimethyl-	trans-2-(2-Pentyl)furan	Octadecanoic acid, 2-methylpropyl ester	cis,trans-2-Ethylbicyclo[4,1,0]decane	Benzene, 1-methyl-3-(1-methylethyl)-	Silane, trimethyl-	4-Methylbenzobicyclophane
2,6-Bis(1,1-dimethylethyl)-4-(1-oxopropyl	5-Hepten-2-one, 6-methyl-	2H-Pyran, tetrahydro-4-methyl-2-(2-methyl	Octanoic acid, 3-methylbutyl ester	Cyclodecene, 1-methyl-	Benzene, 1-methyl-3-propyl-	Cyclohexasiloxane, dodecamethyl-	Benzo[b]thiophene, 3,6-dimethyl-
2-Butyl-2,7-octadien-1-ol	5-Octen-4-one, 7-methyl-	1,2-Benzendicarboxylic acid	Cyclohexanoic acid, methyl ester	Cyclohexane	Benzene, 1-methyl-4-(1-methylethyl)-	Cyclopentasiloxane Octamethyl-	Benzoazole
2-Dodecanol	Acetone	4-Butylbenzoic acid	Pentadecanoic acid, 3-methylbutyl ester	Cyclohexane, 1,4-dimethyl-2-(2-methylpro	Benzene, hexyl-	Cyclopentasiloxane, decamethyl-	Benzyl methyl sulfide
2-Ethyl-1-Hexanol	Acetyphenone, 2,2',5'-dimethyl-	Acetic acid	Pentanoic acid, 2,2,4-trimethyl-3-carboxypropyl	Cyclohexane, pentyl-	Benzene, propyl-	Cyclotrisiloxane, octamethyl-	Carbon disulfide
2-Furanmethanol	Benzoephnone	Benzoic acid	Pentanoic acid, ethyl ester	Cyclohexane, propyl-	Benzene, propyl-	Cyclotrisiloxane, 2,4,6-triethenyl-2,4,6	Cyclic octaatomic sulfur
2-Methyl-2,3-pentanediol	Benzyl methyl ketone	Benzoic acid	Phenyl ethyl acetate	Cyclopentane, methyl-	Benzene, 1-methyl-3-propyl-	Cyclotrisiloxane, hexamethyl-	Dibenzothiophene, 3-methyl-
2-Nonen-1-ol, (Z)-	b-Methyl ionone	Benzoic acid	Phenyl ethyl isobutylate	Naphthalene	Benzene, 1-methyl-4-(1-methylethyl)-	Heptasiloxane, hexadecamethyl-	Dibenzothiophene, 4-methyl-
3,5-Octadien-2-ol	Butylacetone	Butanoic acid	Propanoic acid, 2-methyl-, 2,2-dimethyl-	Naphthalene, decahydro-2-methyl-	Naphthalene, 1,2,3,4-tetrahydro-2,7-dimethyl	Hexasiloxane, tetradecamethyl-	Dimethyl sulfide
3-Buten-2-ol, 4-phenyl-	Caryophyllene	Butanoic acid, 2-methyl-	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydrox	Neopentylidenedicyclohexane	Naphthalene, 1,2,3,4-tetrahydro-2-methyl	1,2,4,5-Tetrazine, 3,6-dipropyl-	Dimethyl Sulfoxide
4-Heptyl-2-ol	Cyclohexane	Butanoic acid, 3-methyl-	Propanoic acid, 2-methyl-, 3-hydroxy-2,4	trans,cis-2,8-Dimethylspirop[5]undecane	Naphthalene, 1,2,3,4-tetrahydro-6-methyl	1,6-Octadien-3-ol, 3,7-dimethyl-, 2-amino	Disulfide
4-Undecanol	Cyclohexanone	Decanoic Acid	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethyl	Decane	Naphthalene, 1,2-dihydro-1,1,6-trimethyl	1H-Indole, 3-methyl-	Disulfide, dimethyl
7-Octen-2-ol, 2,6-dimethyl-	Cyclohexanone, 5-methyl-2-(1-methylethyl	Dodecanoic acid	Propanoic acid, butyl ester	Dodecane	Dodecane	1H-Pyrole, 3-methyl-	Disulfide, methyl propyl
Benzyl Alcohol	Cyclohexanone, cyclic trimethylene aceta	Hexanoic acid	Propanoic acid, ethyl ester	Dodecane	Dodecane	1-Piperidinecarboxaldehyde	Mercaptoacetic acid, bis(trimethylsilyl)
Borneol	Dihydroacetic diolide	Hexanoic acid, 2-ethyl-	Tetradecanoic acid, ethyl ester	Eicosane	Naphthalene, 2,3,6-trimethyl-	2-(3-Methylbutyl)-3,5-dimethylpyrazine	Methanethiol
Butylated Hydroxy Anilole	Ethanoane, 1-(2-hydroxyphenyl)-	Hexanoic acid, allylthiide	Hexadecanoic acid, diisobutyl	Heptadecane	Naphthalene, 2-methyl-	2,4-Toluene diisocyanate	Methyl ethyl disulfide
Butylated Hydroxytoluene	Ethanoane, 1-cyclopropyl-	Hexadecanoic acid	Hexadecanoic acid	Hexadecane	Styrene	2-Acetylpyrrole	Methyl isopropyl disulfide
Cedran-diol, 6S,14-	Ethanoane, 2,2-dihydroxy-1-phenyl-	Nonanoic acid	Diethyl Phthalate	Hexane	alpha-Cubebene	3,6-Bis(N,N-dimethylamino)-9-methylcarbazole	Methyl pentyl disulfide
Cedrol	L-Fenchone	Octadecanoic acid	Phthalic acid, isobutyl octyl ester	Nonadecane	alpha-Murolene	3-Methoxy-2,5-dimethylpyrazine	Methyl thymol ether
cis-Pinen-3-ol	Musk 3BA	Octanoic Acid	2-methoxyethyl ether	Octadecane	alpha-Thujene	4-Acetylaniline	Sulfone, butylpropyl
Cyclohexanol, 2-(1,1-dimethylethyl)-	Nona-3,5-dien-2-one	Pentadecanoic Acid	Benzene, 1,2-dimethoxy-	Pentadecane	beta-Guaiene	Benzenesulfonamide	Sulfur
Cyclopentanol, 2-methyl-, acetate, trans	Nonadecane	Penanoic acid	Benzene, 4-ethyl-1,2-dimethoxy-	Pentane	beta-Mycene	Benzenesulfonamide, N,N-dimethyl-	Sulfurous acid, butyl C66 alkyl ester1
DTBBP	Thujone	Propanoic acid	Calicene epoxide	Tetradecane	beta-Pinene	Benzyl nitrile	Sulfurous acid, butyl C66 alkyl ester2
Eugenol	Tonalide	Sorbic Acid	d-Butyl Ether	Undecane	1R-alpha-Pinene	Benzylcarbamate	Sulfurous acid, butyl C66 alkyl ester3
Menthol	Verbenone	Tetradecanoic acid	Diphenyl ether	Unicosane	3-Carene	Butanamide, 3,3-dimethyl-	Sulfurous acid, butyl C66 alkyl ester5
Phenol	1-Cyclohexene-1-carboxaldehyde, 2,6,8-tr	Tetradecanoic acid, 2-hydroxy-	Ethanol, 2-phenoxy-	Ethanol, 1,1,1,3,5,5,7,7-Nonamethyl-3-(trimethy	3-Cyclohexene-1-methanol, alpha-, alpha	Butanamide, n-pentyl-	Sulfurous acid, butyl C66 alkyl ester6
Phenol, 2-(1,1-dimethylethyl)-4-methyl-	2-Furanicarboxaldehyde, 5-methyl-	2-Propenoic acid, butyl ester	Eugenyl methyl ether	1-Hexene, 2,5-dimethyl-	alpha-Cubebene	Decanamide, n-pentyl-	Sulfurous acid, butyl C66 alkyl ester7
Phenol, 2,3,5-trichloro-	2-Octenal, (E)-	2-Octenal, (E)-	2-Methylheptyl acetate	2,3-Dimethyldecane	b-Camphene	Diethyl sulfide	Sulfurous acid, butyl C66 alkyl ester8
Phenol, 2,4-bis(1,1-dimethylethyl)-	2-Propenal, 3-phenyl-	2-Propenal, 3-phenyl-	3-Decanoic acid, ethyl ester	Hexane, 2,4-dimethyl-	b-Bourbonene	Ethanesulfonamide, N,N-dimethyl-	Sulfurous acid, butyl cyclohexylmethyl ester
Phenol, 2-methyl-5-(1-methylethyl)-	3,5-di-tert-Butylcyclohexyl acetate	3,5-di-tert-Butylcyclohexyl acetate	4-tert-Butylcyclohexyl acetate	Pentane, 1-butoxy-	b-Patchoulene	Ethanoane, 1,2-diphenyl-, oxime	Tetrahydrothiazole
Phenol, 4-(1-methyl-1-phenylethyl)-	Benzaldehyde	Benzaldehyde	Acetic acid, 2-phenylethyl ester	tert-Butyl Methyl ether	Calamene	Formamide, N,N-diethyl-	Tetraulfide, dimethyl
Phenol, 4-(2-propenyl)-	Benzaldehyde, 2,4,5-trimethyl-	Benzaldehyde, 2,4,5-trimethyl-	Acetic acid, butyl ester	1-Methoxy-2-propyl acetate	Camphene	Hexanenitrile	Thiophene-2-acetic acid, dodec-9-ynyl ester
Phenol, 4-(1-methylethyl)decyl-	Benzaldehyde, 2,4,8-trimethyl-	Benzaldehyde, 2,4,8-trimethyl-	Acetic acid, hexyl ester	1-Propoxy-2-ethyl formate	Caryophyllene	Indole	Thioxanthene
Phenyl Ethyl Alcohol	Benzaldehyde, 2,4-dimethyl-	Benzaldehyde, 2,4-dimethyl-	Benzenepropionic acid, ethyl ester	2-Bromomethyl acetate	Diethyl sulfide	N,N,3,5-Tetramethylaniline	1,2-Dimethoxy-3,5-dichloro-benzene
alpha-Isomethyl ionone	Benzaldehyde, 3,4-dimethyl-	Benzaldehyde, 3,4-dimethyl-	Benzenepropionic acid, pentyl ester	2-Ethoxyethyl acetate	Ethylbenzene	N,N-Dimethylformamide	2,6-Dichloro-4-(1,1-dimethylethyl)phenol
D.(+)-Carvone	Benzaldehyde, 4-ethyl-	Benzaldehyde, 4-ethyl-	Benzyl Benzoate	Phenol, 4-methoxy-, acetate	m,p-Xylene	Estragole	3-Trifluoroacetoxypentadecane
1-(4-tert-Butylphenyl)propan-2-one	Benzaldehyde, 4-hydroxy-	Benzaldehyde, 4-hydroxy-	Bornyl acetate	2-Propanol, 1-butoxy-	o-Xylene	Limonene	Benzenamine, 3,4-dichloro-
1-(2-(2-(2-Acetylloxiran-2-yl)-1,1-dimeth	Benzaldehyde, 4-pentyl-	Benzaldehyde, 4-pentyl-	Butanoic acid, 3-methyl-, 3-methylbutyl	2-Propanol, 1-ethoxy-	Toluene	Pentane, 2-isocyanato-2,4,4-trimethyl-	Benzene, 1,2-dichloro-3-methyl-
2(1H)-Naphthalenone, 3,4,4a,5,6,7 hexayl	Butanal, 2-methyl-	Butanal, 2-methyl-	Butanoic acid, propyl ester	2-Propoxy-1-ethoxy-	1,1-Biphenyl-, 4-methyl-	Phenylsulfonfylacetanilide	Benzene, 1,4-dichloro-
2(3H)-Furanone, 5-butylidhydro-	Butanal, 3-methyl-	Butanal, 3-methyl-	Decanoic acid, ethyl ester	Diethylene glycol diethyl ether	1,2,3,5-Tetramethylbenzene	Bromoforn	Bromoforn
2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,	Decanal	Decanal	Decanoic acid, methyl ester	Dipropylene glycol methyl ether	1H-Indene, 1-ethylidene-	Pyrazine, 2,3-dimethyl-	Butane, 1,2,2-tribromo-
2,6-Bis(1,1-dimethylethyl)-4-(1-oxopropyl)phenol	Dodecanal	Dodecanal	Decanoic acid, methyl ester	Dipropylene glycol monomethyl ether	1H-Indene, 2,3-dihydro-1,1,3-trimethyl-3-phenyl	Pyrazine, 2-ethyl-6-methyl-	Chloroform
2,6-di-tert-Butylquinone	Furfural	Furfural	Di(sec-butyl) 2-methylsuccinate	Ethane, 1,1'-oxybis[2-ethoxy]-	1H-Indene, 2,3-dihydro-4,7-dimethyl-	Pyrazine, 3-ethyl-2,5-dimethyl-	Cyclopropane, pentachloro-
2-Butanol	Heptanal	Heptanal	Diisobutyl adipate	Ethane, 1,1'-oxybis[2-ethoxy]-	1H-Indene, 2-butyl-5-hexyloctylidhydro-	Pyrazine, ethyl-	Dibromochloromethane
2-Butanol, 3-methyl-	Hexanal	Hexanal, 2-ethyl-	Diisobutyl succinate	Ethane, 2-(2-ethylhexyloxy)ethoxy]-	1H-Indene, 2-methyl-	Pyrazine, trimethyl-	Methane, bromodichloro-
2-Buten-1-one, 1-(2,6,6-trimethyl-1,3-cy	Hexanal, 2-ethyl-	Hexanal, 2-ethyl-	Dodecanoic acid, 1-methylethyl ester	Ethanol, 2-butoxy-	2,4-Dimethylstyrene	Pyridine	Methylene Chloride
2-Decanone	Isophtalaldehyde	Isophtalaldehyde	Dodecanoic acid, ethyl ester	Triethylene glycol ethyl ether	2,6-Disopropyl-naphthalene	Pyridine, 2,3-dimethyl-	Phenol, 2-chloro-4-(1,1-dimethylethyl)-
2-Hexanone	Linal	Linal	Ethyl Acetate	1,4-Cyclohexadiene, 1-methyl-4-(1-methyl	Acenaphthene	Pyridine, 2-ethyl-	Tetrachloroethylene
2-Methyl ionone	Nonanal	Nonanal	Ethyl Benzoate	Cyclohexane, 2-propenyl-	Cyclohexane, 2-propenyl-	Pyridine, 2-methyl-	
	Octanal	Octanal	Formic acid, butyl ester	Cycloisopropylene, 8,10-dihydro-	Anthracene, 1-methyl-	Pyridine, 3-methyl-	
	Octanal, 2-(phenylmethyl)ene-	Octanal, 2-(phenylmethyl)ene-	Geranyl acetate	Isopropylolene, 4,5,9,10-dihydro-	Azulon	Pyridine, 3-phenyl-	

< 50 µg/m³
50-500 µg/m³
> 500 µg/m³

Lab.



Toxic Units (Health Exposure Units, HEU)

$$HEU_c = \sum \frac{[]_i}{AQC_i}$$

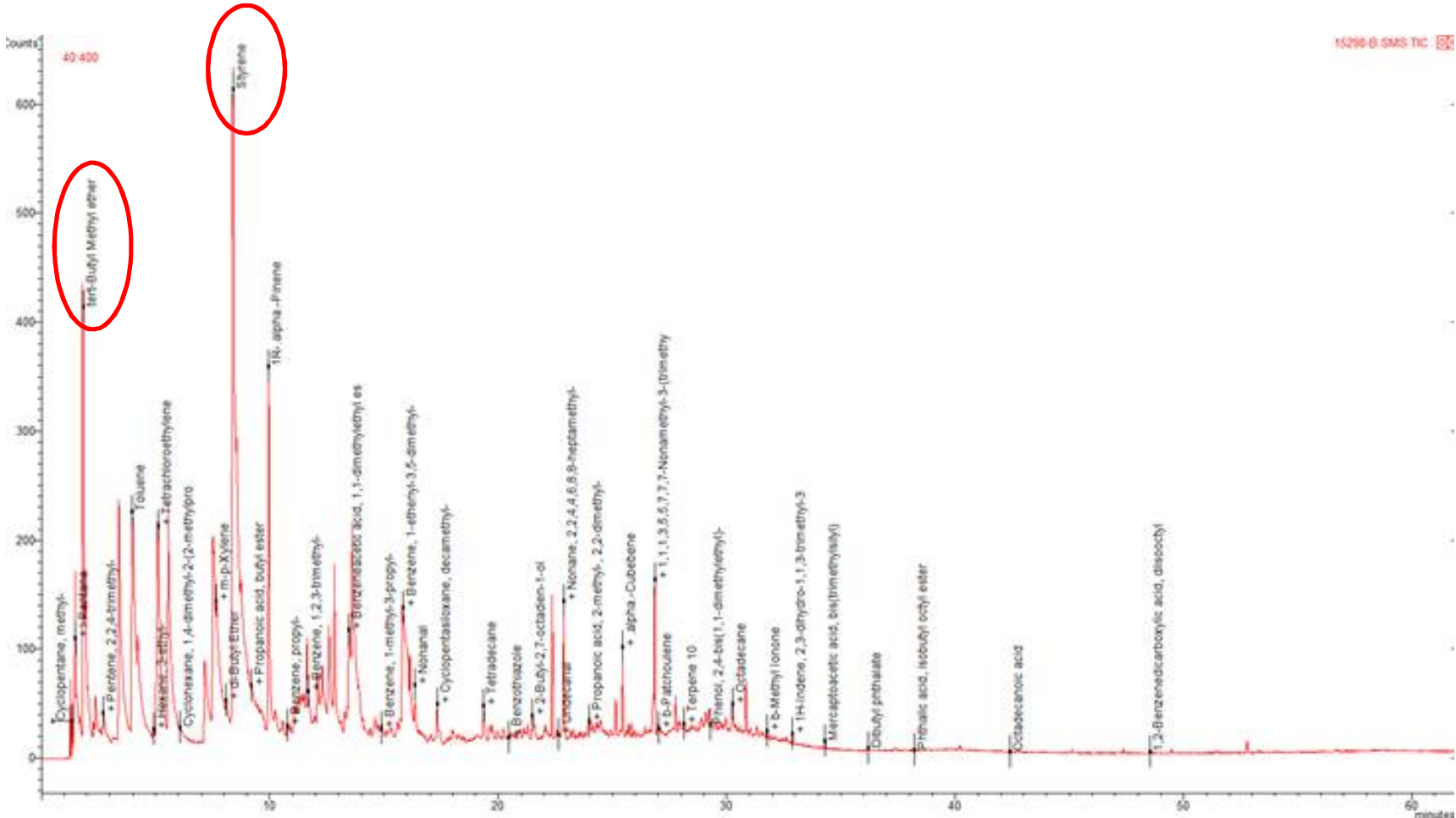
Indoor air quality following NTP 972 from INSHT (2013)

Health effects	Toxic units (HEU)
none	<1
some-light	1-10
frequent-important	10-100
very frequent-serious	>100

Wlab.



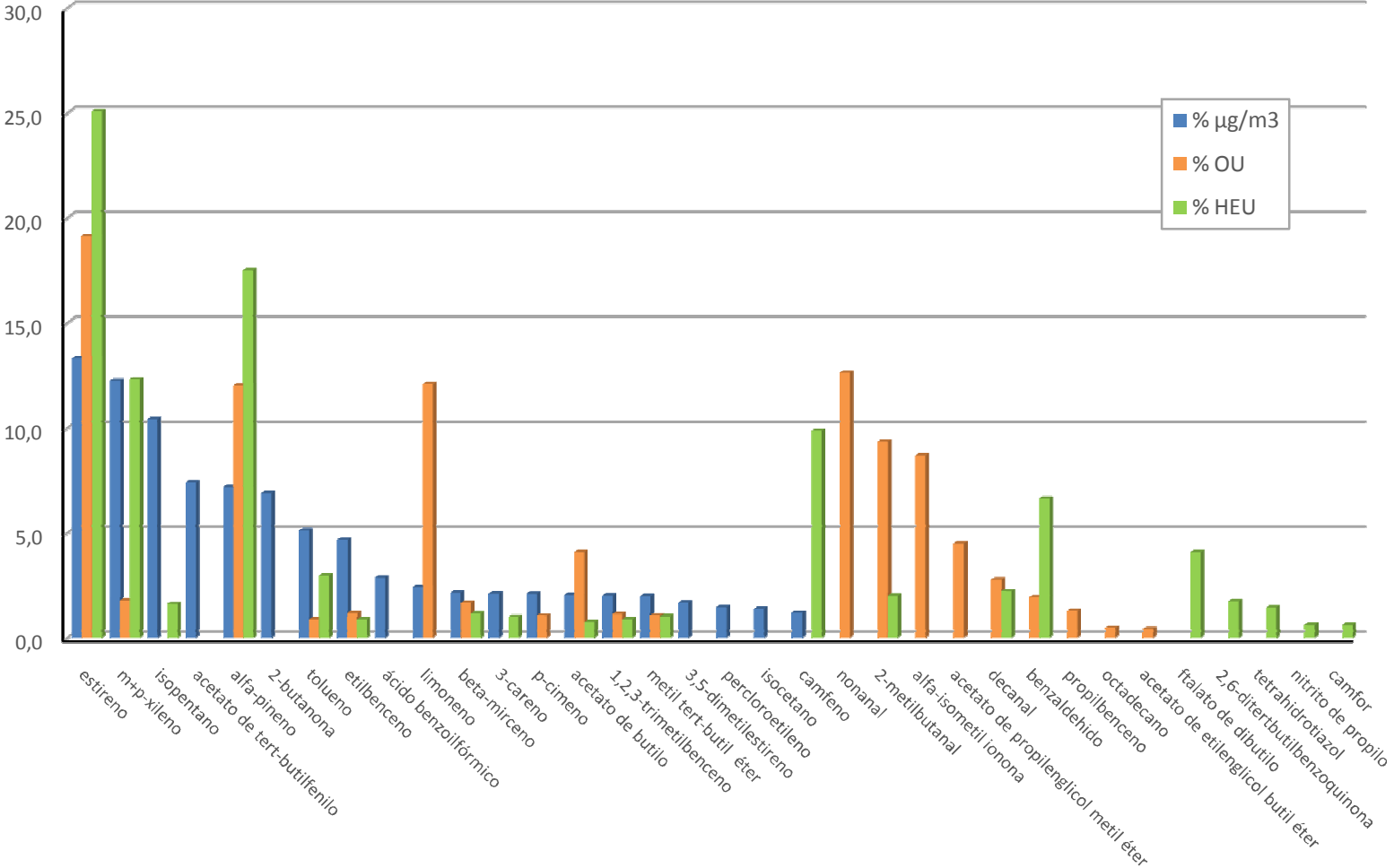
Real Example I. Single source identification



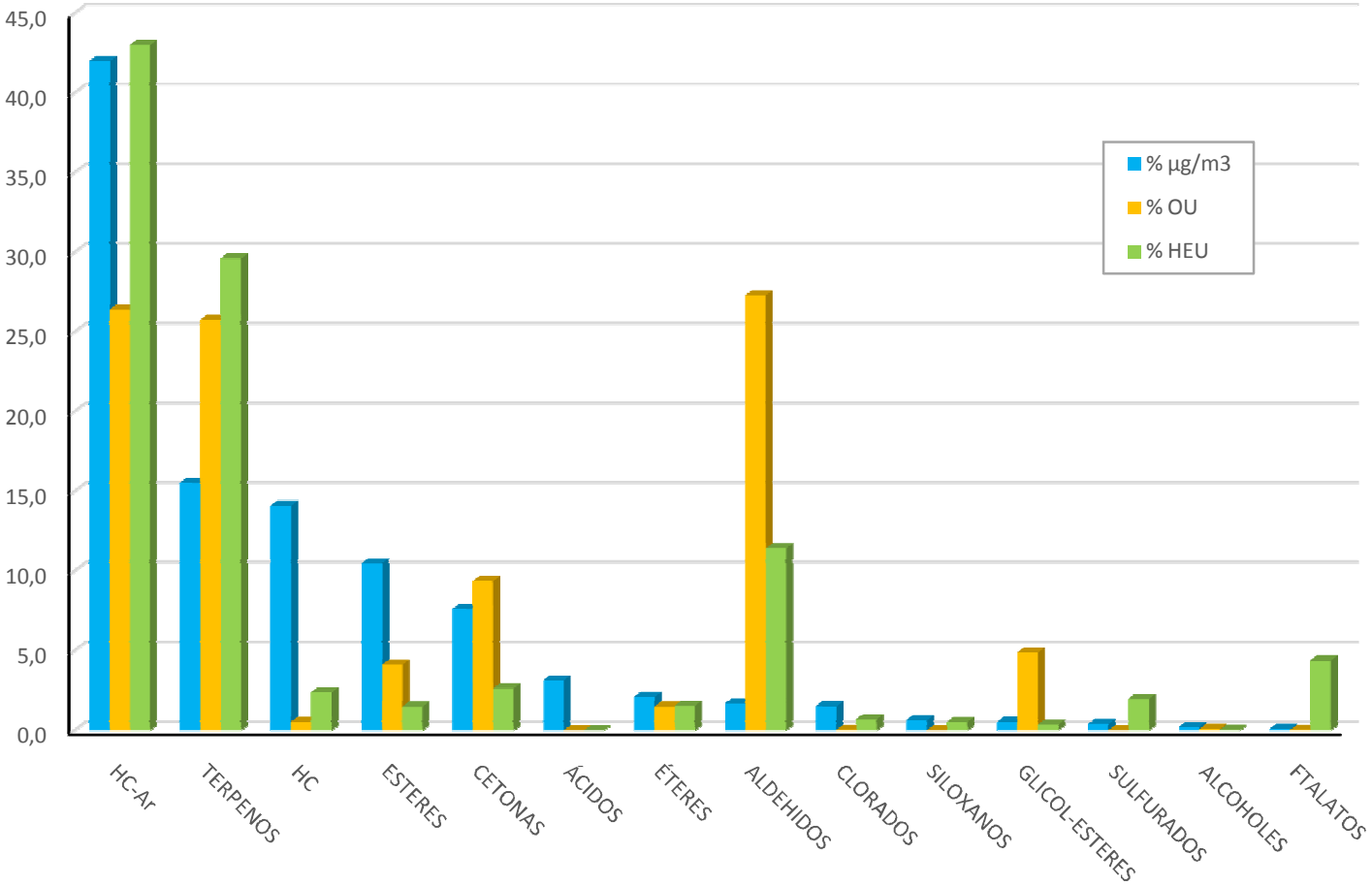
Salab.



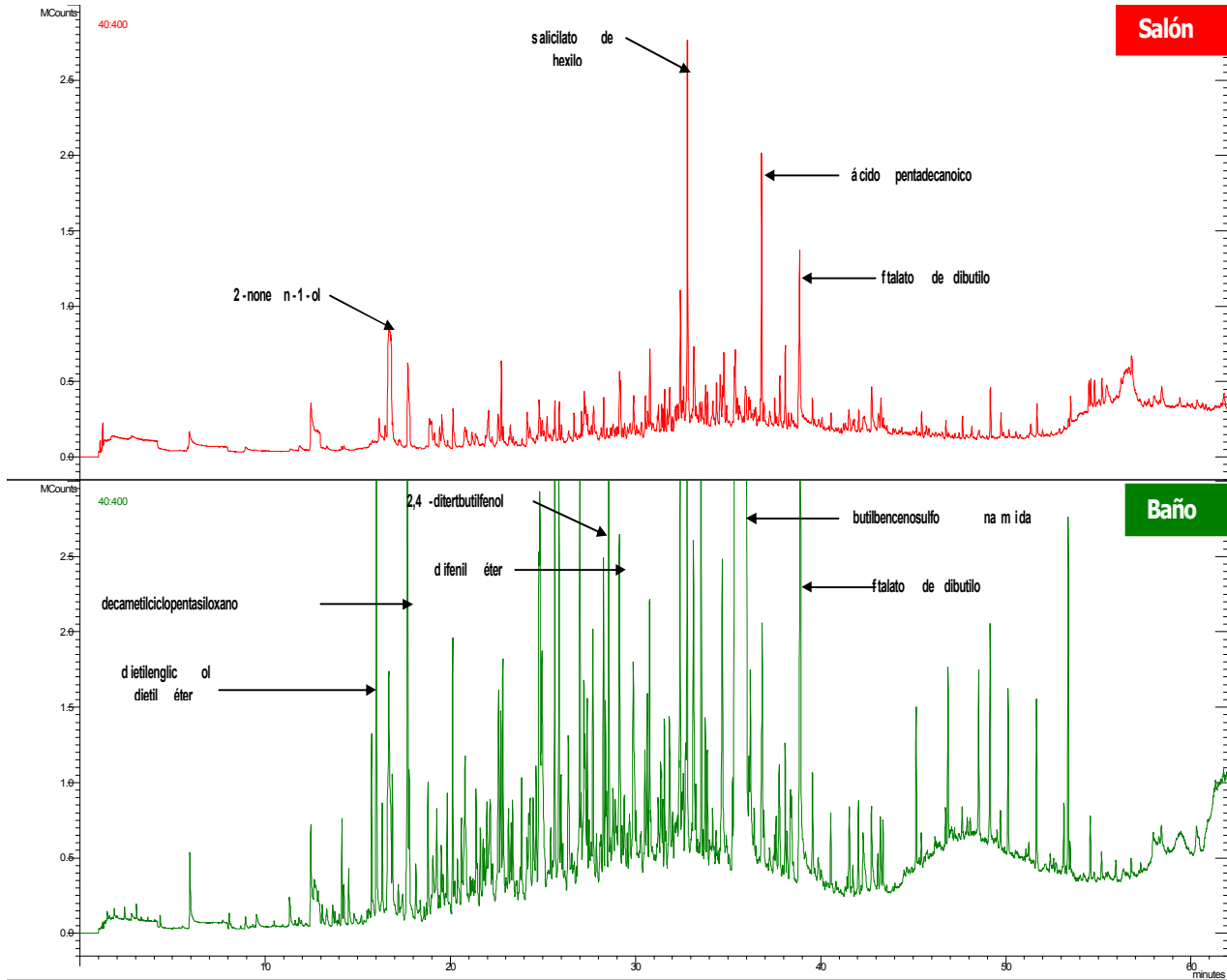
Concentration, OH & HEU (%)



Concentration, OU & HEU (%). By Chemical Family

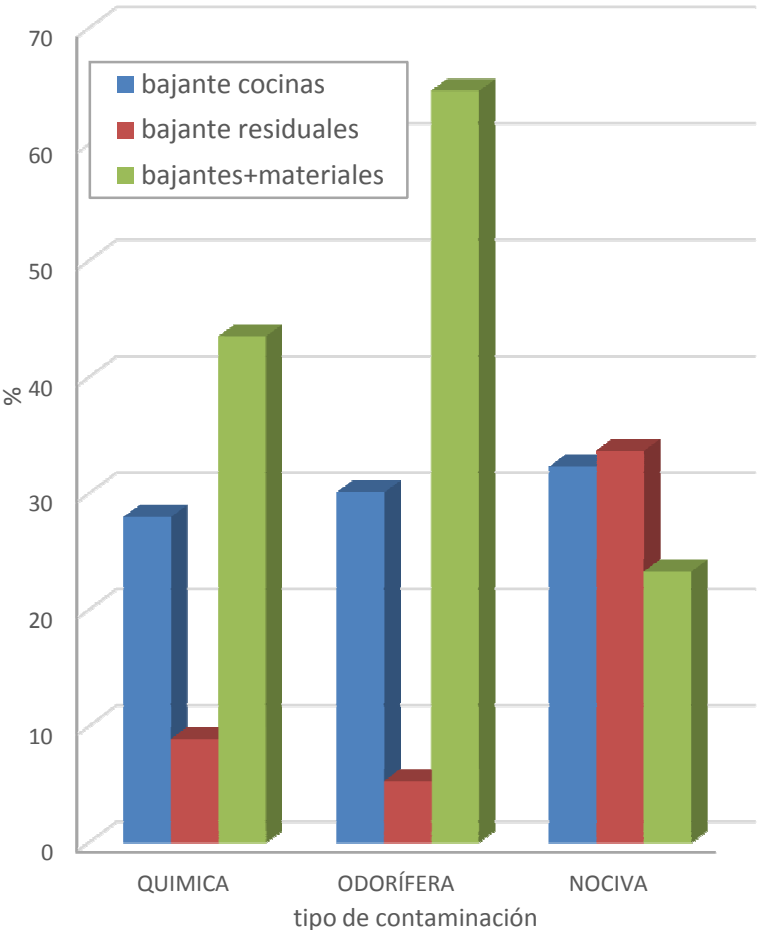


Real Example II. Multiple source identification

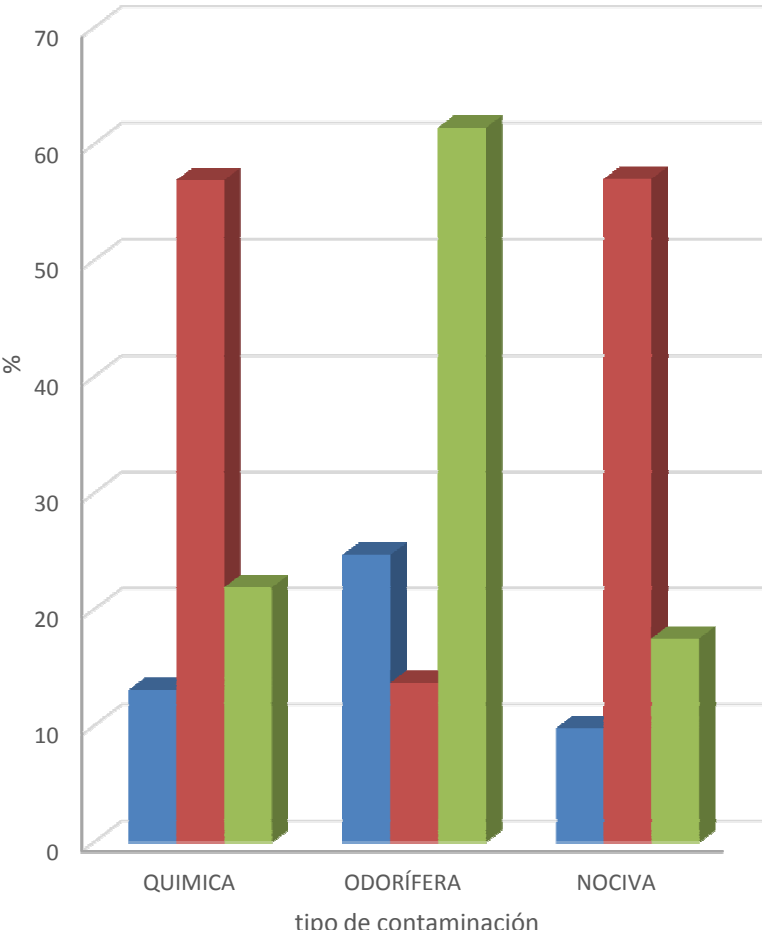


Concentration, UO & UEP (%)

Salón



Baño



Probable sources of majority chemical compounds

Localización	Compuesto	Familia	Materiales reforma	Bajantes	Shunt
salón	2-nonen-1-ol	ALCO	antioxidante y fragancias yeso, emplastes, conglomerados, protectores UV	alcantarillado	
	benzaldehido	ALDE			
	salicilato de hexilo	ES	inhibidor de corrosión	detergentes, suavizantes fragancias	
	2-etilnaftil éter	ET			
	3-fenil-2-propenal	ALDE			
	metilmercaptano	S			
octadecano	H	plastificante PVC	alcantarillado alcantarillado		
p-cumilfenol	ALCO	antioxidante policarbonato	moho		
baño	2,4-ditertbutilfenol	ALCO	antioxidante polietileno, lubricantes, estabilizador gomas		fragancias, jabones
	2,6-dimetil-7-octen-2-ol	ALCO	aislante, plastificante de poliamidas (nylon)		
	butilbencenosulfonamida	N			
	difenil éter	ET	fluido intercambiador de calor y lubricantes		
	dietilenglicol dietil éter	GLI-ET	pinturas, tuberías alineamientos cemento		
	decametilciclopentasiloxano	SILO	desengrasantes, lubricantes		
bisfenol A	ALCO	antioxidante policarbonato y revestimientos tableros con poliuretano	alcantarillado alcantarillado	perfumes	
undecanal	ALDE	ceras lubricantes, aislantes			
nonadecano	H				

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Most likely sources of the compounds responsible for the perceived odor

localización	tipo olor	compuesto	familia	materiales de construcción recientes	elementos comunes evacuación/ventilación
salón	fecal-húmedo	benzaldehido	ALDE	emplastes, conglomerados, protectores UV emplastes	alcantarillado
		octanal	ALDE		alcantarillado
salón	fétido	metilmercaptano	S		alcantarillado
		escatol	N		
baño	fecal-húmedo	nonanal	ALDE	recubrimientos tuberías, rellenos neopreno, emplastes, linoleum, resinas oléicas	alcantarillado
		decanal	ALDE		alcantarillado
	fecal-shunt	alfa-isometilionona	CE		productos de limpieza y fragancias
		2-metilbutanal	ALDE		suavizantes y cosméticos
baño	químico-sintético	undecanal	ALDE	aislantes de sellado	alcantarillado
		difenil éter	ET	resinas epoxi y recubrimientos tuberías	conservante detergentes y cosméticos desodorizantes
baño	químico-sintético	etilenglicol fenil éter	GLI-ET	pinturas,colas, relleno gomas	
		fenilmetanol	ALCO		
baño	goma quemada	2,4-ditertbutilfenol	ALCO	estabilizador gomas sintéticas sellados y recubrimientos goma	
		2-octilmercaptano	S		

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Conclusions

- SPME with dynamic adsorption is a proven technique to monitor Volatile Organic Compounds (VOCs) in air.
- Constant flow and total volume are the most important parameters to make results reproducible.
- Identification (qualitative) and quantitation are available approaches to give good results in indoor air analysis.
- Interpretation is possible by calculating Odor Units (UO), to correlate actual odor measurements and Nocive Units (UEP)

SALab.



SWLab.

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